APPENDIX F

MASS-PRODUCTION OF TARGETS

BY

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Mass Production of Direct Drive IFE Targets

by

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at

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GENERAL ATOMICS

Cooperation will be required of all concerned for IFE to succeed

- Target design
- Target fabrication
- Filling
- Layering
- Injection and tracking
- First wall/chamber interactions
- By-product removal and recycle

Total cost of target delivered to tank center must be considered

- Cost goal for filled and layered target, delivered to tank center: ~$0.25
- Delivery rate: 5 per second = 0.4M per day = 157 million per year
- Mass production techniques will be required to meet cost and throughput goals
- Automation of fill, layering and injection will be required
- Two approaches toward fabrication of affordable targets for IFE
  - Figure out how to economically make ignition targets based on ICF target designs and ICF target fabrication techniques
  - Invent new mass fabrication techniques to produce IFE targets

What are the characteristics of potential target fabrication techniques

- Characteristics of ICF target production processes
  - Flexible
    - Easy to change target fabrication parameters
    - Easy to change target design
  - Low cost for short production runs
  - Low yield (often)
  - Labor intensive
  - Extensive product characterization

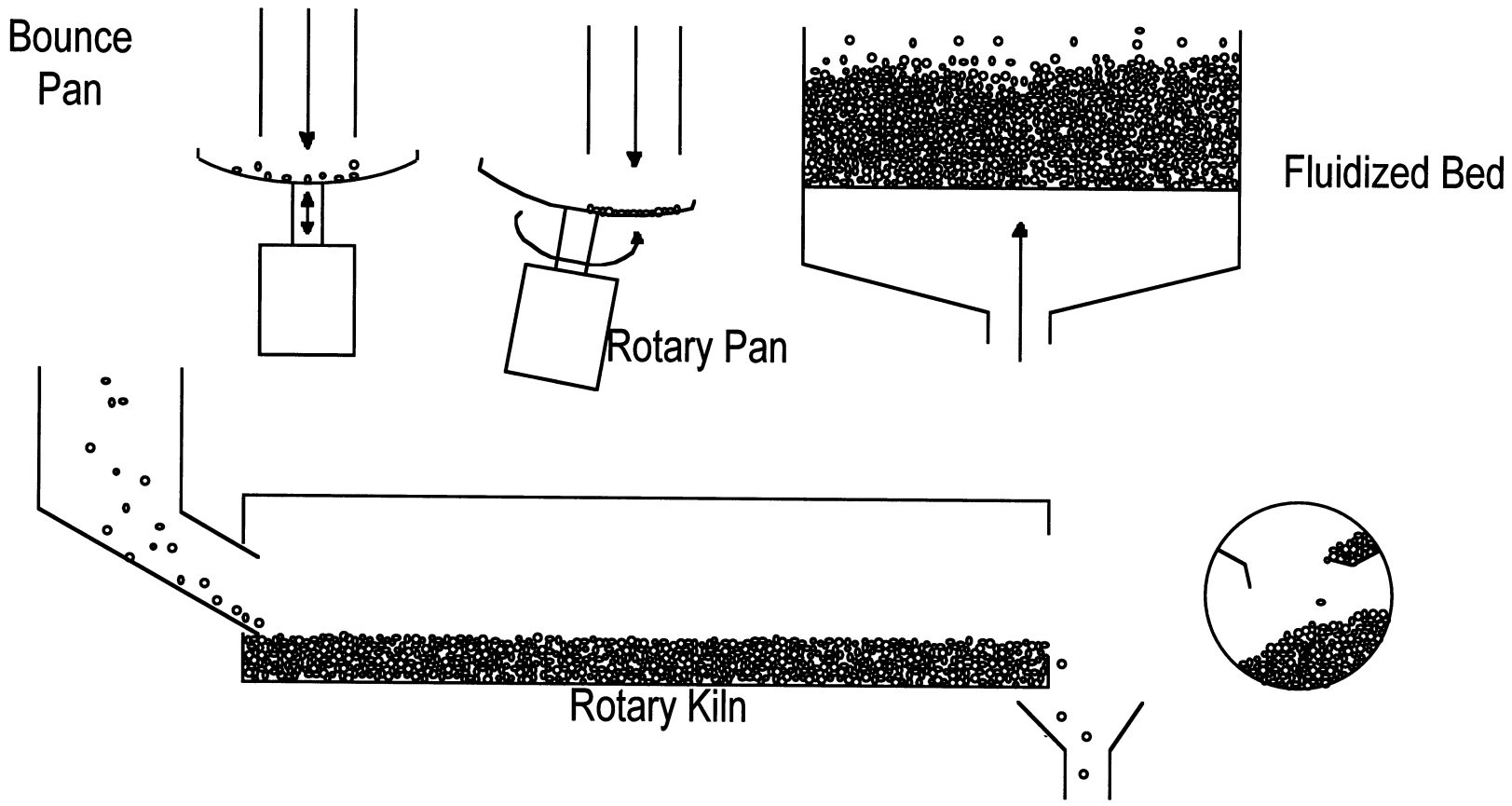
Note: No target quality foam shells have ever been made and characterized at any size

- Characteristics of high rate commercial production processes
  - Inflexible
    - Optimized for a single product design
    - Optimized for a narrow range of product parameter variations
  - Low cost for high rate production
  - High yield
  - Capital intensive
  - Statistical process control sampling

Conceptual foam shell fabrication techniques

- Fabrication of open cell foam shells
  - Micromachining
    - Produce bulk low density foam — Considerable laboratory development
    - Micromachine hemishells — Limited experience base – Expensive!!!
  - Microencapsulation
    - Produce gel shells via 3-fluid nozzle — Limited experience base
      - Polymerization – monomers A and B polymerize in a solvent to form an insoluble network(RF)
      - Precipitation – a polymer dissolved in a solvent precipitates as an insoluble network due to a temperature change (TPX)
    - Harvest
    - Extract solvent via supercritical fluid technique — Limited experience base
- Coating foam shell
  - GDP (Gas Discharge Polymer) – can produce doped polymer
    - Bounce pan — Standard ICF technique – Expensive!!!
    - Tilted rotary pan — Limited experience base – Expensive!!!
    - Rotary kiln style apparatus — Speculative – potential large scale operation
    - Fluidized bed apparatus — Speculative – potential large scale operation
  - Interfacial polymerization – may allow limited production of doped polymer
    - Begin with harvested wet gel shell
    - Extract central droplet using excess of phase 2 solvent
    - Replace solvent with solvent containing monomer A
    - Harvest
    - Add to immiscible solvent containing monomer B
    - Polymerize A with B at the solvent-solvent interface
    - Harvest
    - Extract solvent via supercritical fluid technique

Potential IFE Target Coating Techniques



Speculative foam shell fabrication techniques

- Open cell foam shell with integral coating via 3-fluid nozzle technique
  - Produce gel shells via 3-fluid nozzle via A-B polymerization technique with a known excess of A
  - Use insoluable stripping fluid containing monomer C – polymerize A-C at the interface
  - Harvest
  - Extract solvent via supercritical fluid technique
  - Coat with dopant in fluidized bed or rotary kiln
- Open cell foam shell with integral coating in a rotary mold
  - Partially fill split mold with solvent and polymer
  - Heat to dissolve polymer
  - Cool while rotating to form gel shell
  - Eject
  - Extract solvent via supercritical fluid technique
  - Coat with dopant in fluidized bed or rotary kiln

Rotomold Fabrication of Foam Shells